INSTRUCTION MANUAL

BARBER COLMAN

NO. IN 1211.3-6
(Formerly 6405A)

Capacitrols

model 405P

BARBER-COLMAN COMPANY
Industrial Instruments Division • Rockford, Ill., U.S.A.

INDEX

INSTRUCTION MANUAL—MODEL 405P INDICATING CONTROLLER

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NOTE: This instruction manual to be given to persons responsible for installation and maintenance of this instrument.

Model 405P Serial No. 75A0094 and below use Inst. Man. No. 6405.

Model 405P Serial No. 75A0095 and above use Inst. Man. No. IN 1211.3-6.

UNPACKING INSTRUMENT

This precision instrument and its associated equipment have been carefully manufactured and packed at the factory. Remove the instrument and accessories from the packing box and check items against the packing slip. If the equipment is found to be damaged in transit, report extent of damage to the carrier immediately. Repack in original packing box until ready for installation.

CAUTION:

Handle with care.
Safeguard instrument from shock.
Avoid oil accumulation.
Keep instrument temperature under 130° F.

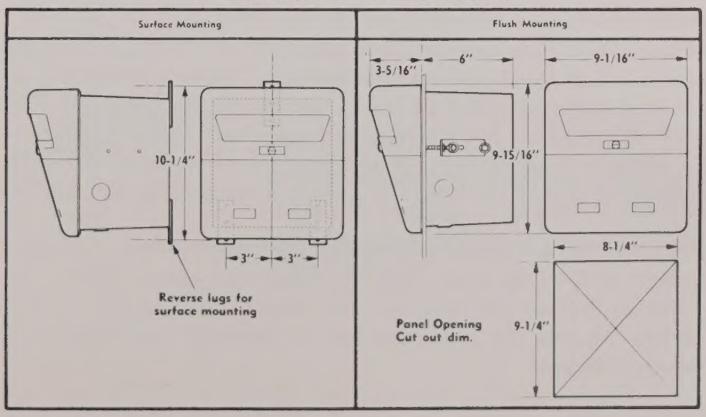
MOUNTING INSTRUCTIONS

Locate the instrument to avoid shock, excessive vibration, moisture and temperatures over 130° F. Avoid furnace walls, radiation of heat, machine frames and outside walls. Provide suitable shelter to avoid moisture and temperature extremes if installed outdoors.

For surface mounting, attach the three lugs (provided) to the back of the instrument housing. See the surface mounting dimension drawing.

For flush or panel mounting, remove the angle brackets from the cloth bag, insert the instrument through the panel opening, attach brackets to the side of the instrument housing and tighten firmly. See the flush mounting dimension drawing.

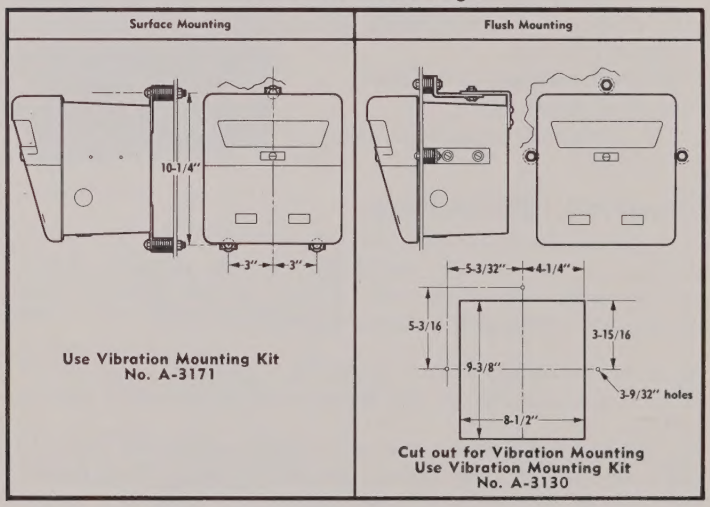
MOUNTING DIMENSIONS



Vibration mounting kits should be used if the vibration causes erratic temperature readings or control. See the vibration mounting dimension drawing for details of surface or flush mounting. Special provisions may have to be considered if the instrument is subjected to severe shock such as from a drop forge or similar type of equipment.

Moderate care should be taken to mount the instrument level.

MOUNTING DIMENSIONS
Vibration Mountings



POWER WIRING

Remove the lower section of the front cover to expose the terminal strips and the control chassis. To expedite wiring, grasp the side plates of the chassis and pull forward to remove. Check the rating plate on the chassis for the supply voltage and frequency. Connect proper voltage and frequency to terminals L1 and L2. Supply voltage should be 110 to 130 VAC or 220 to 260 VAC depending on chassis specifications. Run all wiring in rigid conduit, BX or Greenfield, in accordance with the recommended electrical code. Use properly fused switches, see diagram.

Solid wire (14 ga.) is recommended for instrument wiring. If stranded wire is used, tin the ends to provide secure connections. Position the wires so they do not interfere with control chassis or the housing gaskets. Ground the instrument case; a grounded conduit system is usually sufficient.

THERMOCOUPLE WIRING

Do not run thermocouple lead wire with other power or control wiring except for thermocouple break (TCB) wires, if used. Several thermocouple lead wires may be run in the same conduit if desired.

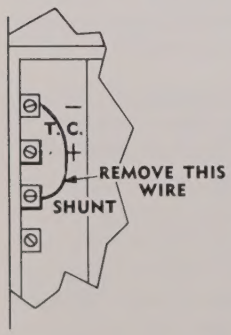
Use only extension lead wire correct for the type of thermocouple (TC) as specified on the scale. The most commonly used types are: Iron-Constantan (I/C or Type J), Chromel-Alumel (C/A or Type K), Platinum-Platinum 10% Rodium (Pt/Pt 10% Rh or Type S), Platinum-Platinum 13% Rhodium (Pt/Pt 13% Rh or Type R), and Heat-Eye. Ordinary copper wire will NOT serve the purpose.

Proper polarity (+) and (—) of the lead wire must be observed to obtain correct readings. The negative wire is usually coded red. Correct polarity of the lead wire can be checked by heating a temporary junction of the lead wire far end. Deflection of the indicator upscale indicates correct polarity of the lead wire.

The thermocouple should then be connected to the lead wire and the indicating pointer should again deflect upscale when the thermocouple hot junction is heated. If the indicator moves downscale, reverse only the connections at the thermocouple head since the lead wire has already been correctly connected to the instrument.

The lead wire may be inserted in the terminal post holes and the binding screw tightened or connected under the screw head if lugs are used. Locate the lead wire so it does not interfere with the control chassis or housing gaskets.

METER SHUNT WIRE



After the instrument is installed, disconnect the jumper wire across terminals "Shunt" and "TC—". This wire is used to shunt or dampen the meter movement for protection during shipping, installation and handling of the instrument but should be removed for normal operation.

NOTE: Replace this shunt wire when handling or reshipping the instrument and position the red control point indicator to the top of the scale.

LINE COMPENSATING RESISTOR (KIT NO. A-3497)

The external resistance, combined resistance of the extension lead wire and thermocouple, for which the meter has been calibrated is marked on the meter scale. Most meters are calibrated for 15 ohms (Ext. Res. 15 ohms) which is more resistance than most lead wire runs. The balance of the resistance, 15 ohms minus the actual external resistance, will be inserted on a removable resistance strip located just under the meter section. The resistance value is marked on the strip and is inserted at the time of the original order. Other values are available, however, lead wire length can be changed up to 25 ft. without appreciable error in reading because a high resistance movement is used.

THERMOCOUPLE BREAK PROTECTION (TCB)

The instrument is equipped with thermocouple break (TCB) protection. Essentially it is a small DC voltage that can be wired into the thermocouple circuit to drive the movement upscale in case of an open circuit in the thermocouple, thus passing the control set point and causing the instrument control to go to the off position. It is not necessary to make the TCB connections for normal operation of the instrument, but its use may be desirable on some applications to guard against overheating in event of an open thermocouple.

The preferred method of connecting TCB is shown in Fig. 1. Use extension lead wire as required to make the connections between the instrument TC terminals and the thermocouple head. Use 14 gauge copper wire to connect the TCB terminals to the thermocouple head, observing polarity. Wiring for TCB may be run in the same conduit with thermocouple lead wire. As the resistance of the thermocouple is low compared to the resistance of the meter movement, TCB compensation is seldom required.

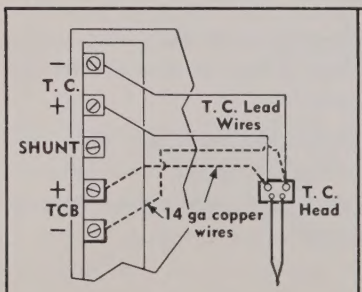


Fig. 1

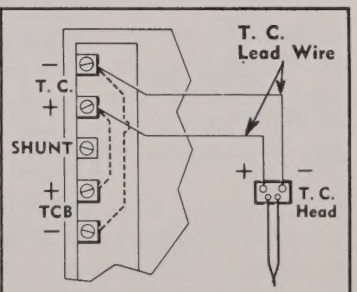


Fig. 2

The optional method of connecting TCB is to use jumpers at the instrument terminals as shown in Fig. 2. As the length of lead wire used affect the amount of TCB compensation required, it is suggested that this method be used with short lead wire lengths, 10 ft. or less and that the amount of TCB error be checked.

To check for TCB operation, disconnect the thermocouple to simulate a broken thermocouple but leave the TCB wires connected to the lead wire. When the instrument is powered, the indicator should drive upscale above the red control set pointer to cause the control to go to the off position.

TCB is not effective on Heat Eye (radiation head) calibrations because of the compensating network in the Heat Eye.

METER ADJUSTMENTS AND CHECK

After the instrument is mounted, check for the cold junction reading of the meter. Disconnect the lead wire at the instrument. The indicator should come to rest at the ambient temperature of the meter; it is NOT supposed to read zero. Place a thermometer at the TC instrument terminals to read ambient temperature.

If the pointer does not come to rest at the ambient temperature, slowly adjust the screw located on top of the front plastic cover. As the meter has automatic cold junction compensation, it is not necessary to make further corrections as the ambient temperature changes.

To check for thermocouple break error (TCB) if it is connected, it is best to have a steady temperature at the hot junction of the thermocouple. Read the temperature at the indicator. For exact reading, position the eye so the reflected image of the pointer on the mirrored strip disappears behind the pointer itself. This reading to be made with power on the instrument. Then disconnect power to the instrument, remove the control chassis, or disconnect the wires at the TCB terminals and note if the indicated temperature drops. Reconnect to see if temperature rises. If a shift in reading is noticed, usually a small amount if any, adjust the screw on the top of the plastic cover, so the reading with TCB powered is at the same point as read with TCB disconnected. If an adjustment was made, the ambient temperature reading will also shift a like amount.

CONTROL SPECIFICATION MODEL 405P

The Model 405P instrument is primarily a proportional position controller to be used with a Power Unit or Barber-Colman MP control motor. The motor operator can be linked to a valve, damper, rheostat or the equivalent to cause a change in input depending on amount of deviation of the indicating pointer from the control set point. The throttling range or proportioning band is adjustable from approximately ½% to 5% of full scale. A manual reset adjustment is also provided. The control chassis is of the plug-in type to facilitate installation and servicing.

The control point setting knob is located just below the instrument scale and is easily adjusted but protected against accidental shifting. A signal light indicates when the instrument is powered.

DESCRIPTION OF ELECTRONIC CIRCUIT

The Model 405P is a development of an original design. A small vane or flag on the indicating pointer passes between two flat coils mounted on the control set pointer. The output of an oscillator circuit varies depending on the position of the vane in the coils and is fed to a polarized relay. The control motor drives an adjustable resistor to match the oscillator output to the polarized relay. As the control motor shaft rotates, the process input will be proportioned depending on the relative position of the indicator and the control set point.

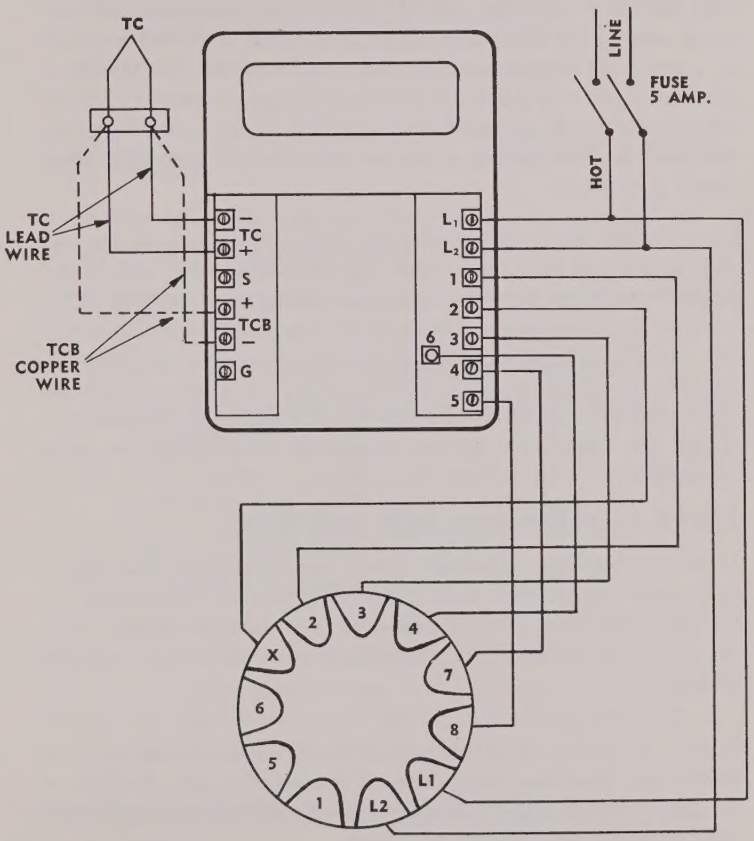
MANUAL RESET

The manual reset adjustment is located on the right front of the control chassis. Adjust CW to lower and CCW to raise the controlled temperature to align the two pointers after the temperature has leveled off at a steady value. A small adjustment will cause a noticeable shift of the proportioning band.

PROPORTIONAL CONTROL

The proportioning band or throttling range adjustment is located on the left front of the control chassis. Adjust CW for minimum proportioning band width and CCW for maximum band. An adjustment of the proportioning band may require a reset adjustment to realign the temperature point with the control pointer.

EXTERNÁL WIRING DIAGRAM



Model 405P Indicating Controller and Barber-Colman proportioning type Power Unit wired for counterclockwise rotation to increase heat input.

For clockwise rotation to increase heat input, interchange connections at terminals 1 and 3 and interchange 4 and 5 at the terminal strip of the Model 405P.

Caution: Do not use a Power Unit with a built-in transformer.

CONTROL ADJUSTMENTS

For initial start-up, set the proportioning adjustment at some arbitrary position toward maximum. Set the red control set pointer at coincision with the black indicating pointer. Observe the motor operator and adjust reset so the motor stops about at midpoint of its full travel. If it is not possible to observe the motor operator, the reading across terminals 4 and 6 of the Model 405P will be approximately 3 VAC or across 5 and 6 will be approximately 8 VAC when the operator is at mid-position. The reading at the test jacks will be zero VDC when circuit is balanced.

Do not make any further adjustments until the temperature has had time to level off to a steady value. For final adjustment, narrow the proportioning band until the temperature cycles, then back off CCW until cycling is no longer present. If the temperature remains steady but the indicator does not coincide with the control set pointer, readjust the reset accordingly. The optimum settings of proportioning band width and reset depends on the heat capacity and thermal lag of each application. Allow time for the temperature to stabilize after each adjustment.

METER MAINTENANCE AND SERVICING

While the 400 Series instrument is well designed and manufactured of high grade components, it is worthwhile to have information for emergency servicing. Where a number of instruments are located in the same area, many parts are interchangeable and allows a minimum inventory.

In event of trouble, the serviceman should familiarize himself with the process and instrument application to ascertain the exact function of the instrument as applied. The trouble usually can be traced to two basic problems, measurement or control.

If the measured temperature is known to be in error, check the following:

(1) Open thermocouple circuit, such as break in thermocouple or lead wiring.

(2) Deteriorated T. C. hot junction due to burning.

(3) Shorted, grounded, or damp lead wire or thermocouple except the thermocouple hot junction may be grounded.

(4) Correct polarity of lead wire and thermocouple.

(5) Check for vibration or shock.

(6) A calibration check for meter accuracy can be made with a Barber-Colman Portable Model 330P or equivalent.

(7) Do not oil or grease any part of the instrument.

In event it is found necessary to remove the plug-in meter assembly, follow these steps:

(A) Remove control set point knob (Bristol #6 wrench).

(B) Remove the four cover screws.

(C) Remove cover straight forward to prevent damage to internal meter parts.

(D) Loosen the two screws in lower meter chassis corners.

(E) Insert fingers behind the two lugs and pull forward carefully to avoid sudden jarring.

(F) Place a jumper wire across the prongs on the back of the meter to dampen the movement.

(G) Position the red pointer to top of scale.

(H) As the meter is exposed, avoid dirt and metal chips.

Reassembly is of reverse procedure, being careful to line up the slotted lever for the zero adjustment pin when replacing the meter cover. Recheck for ambient temperature setting as previously described.

CONTROL MAINTENANCE AND SERVICING

If the control does not function properly and the temperature does not stay at the control point, check the following:

(1) Adjust manual reset to align pointers.

(2) Adjust proportioning band width as previously described.

(3) Replace electronic tube.

(4) Check power to the instrument. Should be 110 to 130 VAC or 220 to 260 VAC depending on chassis specifications.

(5) Check linkage at control motor shaft. Should be firmly connected.

(6) Check for proper ratio of linkage between the control motor and the controlled device.

(7) Replace chassis. Take advantage of the interchangeable plug-in components if other instruments of the same type and voltage are available.

(8) Replace A-3201 microrelay.

(9) Pilot lamp indicates instrument is powered.

(10) Vibration may cause hunting at the control motor, particularly on a narrow proportioning band adjustment.

(11) To alter the control chassis in the field for a different line voltage, change the transformer primary connections per the following; also see internal wiring diagram.

240 volt:

Red to pin 10 (L2)
Green-Yellow to pin 12 (L1)
Connect Red-White to Green and tape.

208 volt:

Red to pin 10 (L2)
Green-Red to pin 12 (L1)
Connect Red-White to Green and tape.

120 volt:

Red and Green pin 10 (L2)
Red-White and Green-Yellow to pin 12 (L1).

(12) DC voltage at test jacks will be zero when circuit is in balance. Depending on position of the operator and relation with indicating pointer, this voltage can go $\pm$ 95 VDC.

SUGGESTED REPLACEMENT PARTS

It is suggested that a few spare parts be carried by the user to insure against possible emergencies and accidental damage. Listed in the order of probable relative need:

	Part No.
*Electronic tube 12AU7	EYZP-70-9
Thermocouple	
Mazda pilot lamp (#51 blue bead)	36-022-1
Chassis complete with Microrelay and 12AU7 tube for	
120 V/60C	A-3585
208 V/60C	A-3570
240 V/60C	A-3586
Microrelay	A-3201

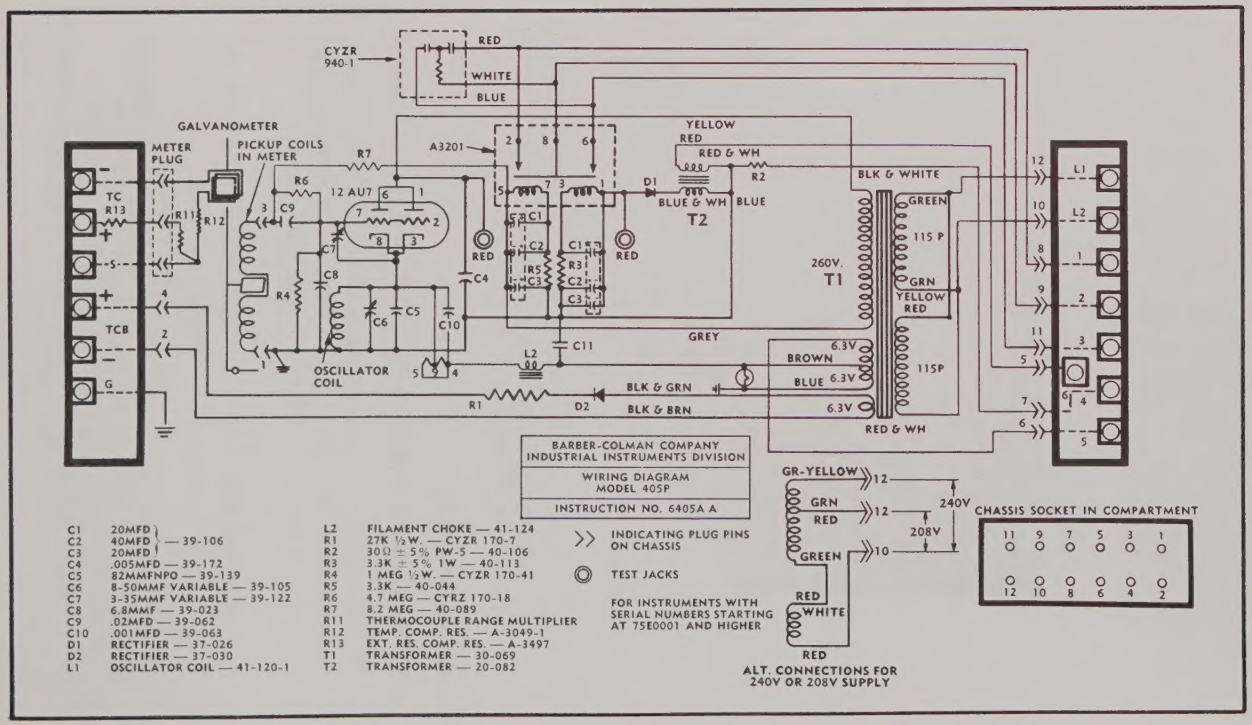
*NOTE: We recommend purchase of the 12AU7 tube from Barber-Colman Company, Industrial Instruments Division, to insure instrument functioning as designed.

THERMOCOUPLES

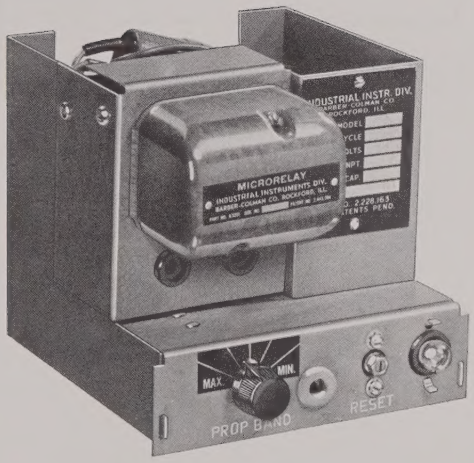
To help you select the best thermocouples for any of your needs, two comprehensive catalogs are available to you without charge. Write to the factory or call your nearest representative.

- - For general purpose thermocouples, request Data Book and Catalog TC-13A.

- - For thermocouples used primarily in the Plastics Industry, request Catalog TC-13B.



C1	20MFD }	L2	FILAMENT CHOKE — 41-124
C2	40MFD } — 39-106	R1	27K ½ W. — CYZR 170-7
C3	20MFD }	R2	30Ω ± 5% PW-5 — 40-106
C4	.005MFD — 39-172	R3	3.3K ± 5% 1W — 40-113
C5	82MMFNPO — 39-139	R4	1 MEG ½W. — CYZR 170-41
C6	8-50MMF VARIABLE — 39-105	R5	3.3K — 40-044
C7	3-35MMF VARIABLE — 39-122	R6	4.7 MEG — CYRZ 170-18
C8	6.8MMF — 39-023	R7	8.2 MEG — 40-089
C9	.02MFD — 39-062	R11	THERMOCOUPLE RANGE MULTIPLIER
C10	.001MFD — 39-063	R12	TEMP. COMP. RES. — A-3049-1
D1	RECTIFIER — 37-026	R13	EXT. RES. COMP. RES. — A-3497
D2	RECTIFIER — 37-030	T1	TRANSFORMER — 30-069
L1	OSCILLATOR COIL — 41-120-1	T2	TRANSFORMER — 20-082



Warranty and Inspection Card

This equipment is guaranteed in accordance with the statement of warranty appearing on our quotation and acknowledgement forms. Upon receipt of this card properly filled out Warranty becomes effective. All Barber-Colman instruments are manufactured to the highest standards of quality and are carefully inspected before packing. Instruments which have been damaged or fail to operate upon installation, should be reported to the Factory at once.

BARBER-COLMAN COMPANY
Industrial Instruments Division

MODEL NO.
SERIAL NO.
CALIBRATION INSP.
FINAL INSPECTION

Date Received		
Company		
Street		
City	Zone	State
By		Title

COMMENTS

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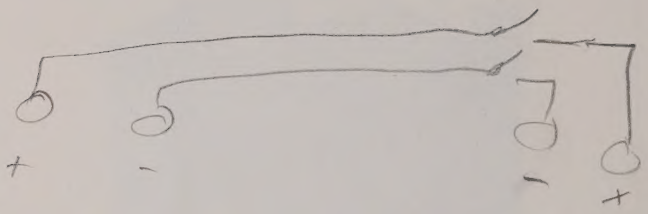

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